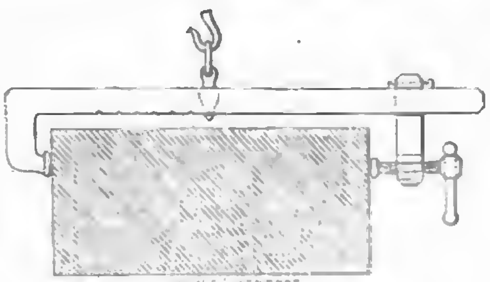
A STONE-LIFTER.



A STONE-LIFTER.

SIR,—Being engaged in the construction of bridges, &c., on the Great Grimsby and Sheffield Junction Railway, and the engineers objecting to lewis-holes in the face of the coping, Mr. Joshua Oliver, clerk of the works, suggested a plan to obviate the difficulty. The annexed sketch is a representation of the apparatus, which is nothing more than a bar of iron, 3½ inches wide and ½ an inch thick, with a sliding piece and screw; but should it be used for rough stones, the screw may be dispensed with by adding a key to the top of the sliding piece, as shewn by the dotted lines.

Thinking it might be useful to other parties, I obtained the sanction of the inventor to forward it for your valuable and most useful paper, hoping you will not deem it unworthy of a corner.—I am, Sir, &c.,

AN OLD SUBSCRIBER.

Morton Gainsbro'.

DEE BRIDGE.

SIR,—I perfectly agree with your remarks respecting the fallen bridge over the Dee at Chester, but though I have given close attention to all the reports, evidence, opinions, &c., as they have successively appeared, I think there is one peculiarity in the structure of this bridge, the effects of which have not been duly estimated, nor, as it appears to me, clearly understood.

I allude to the curvature of the rails over the bridge. I am aware that General Pasley stated, "though he knew of no other iron-girder bridge passing on a curve, yet the curve was so slight that it was scarcely worth mentioning," &c. Also that Mr. Stephenson, in his report, has estimated that the lateral strain from this cause would only be about 750 lbs. But these adverse opinions have not shaken my belief that the curvature of the line had considerable effect in producing the fall of the bridge, and I think nothing can shew more plainly the folly of pinning your faith on great names than this accident, and the subsequent investigations.

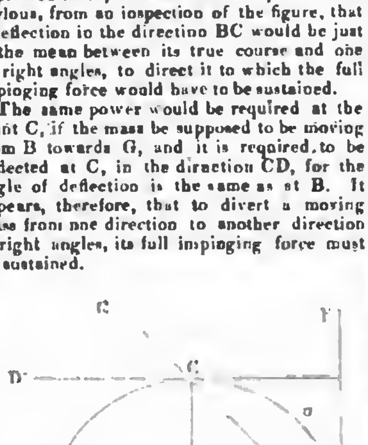
It is a matter of first importance to arrive at just conclusions in a question like this, as improved experience can only thus be obtained, and this is the only beneficial result that can arise from such a calamity. I trust, therefore, you will excuse a little prolixity in my endeavouring to make clear this point.

The curve in question had a radius of two miles.

In the following diagram, let ABC be a circle of four miles in diameter, and the portion B*a*C a quadrant of that circle, and consequently a curve with a radius of two miles. Let EB be the direction of any moving mass. Draw a straight line from B to C and produce it towards G. Produce EB also towards F, and draw CD perpendicular to EF.

Suppose a mass with uniform motion, and having an impinging force of 200 tons moving from E towards F. To arrest this motion at B, or turn it at right angles in the direction BA, it will be requisite to have a power at B capable of sustaining an impinging force of 200 tons. But if instead of arresting the motion at B, it is only required to divert it in the direction BC, half this force will be sufficient; for it is an established law, "that every change of motion must be proportional to the impressed force, and the converse;" and it is obvious, from an inspection of the figure, that a deflection in the direction BC would be just in the mean between its true course and one at right angles, to direct it to which the full impinging force would have to be sustained.

The same power would be required at the point C, if the mass be supposed to be moving from B towards G, and it is required to be deflected at C, in the direction CD, for the angle of deflection is the same as at B. It appears, therefore, that to divert a moving mass from one direction to another direction at right angles, its full impinging force must be sustained.



This is precisely what is accomplished by a railway curve, and as it is an axiom that like effects are produced by like causes, it follows, that though the mass moving from E towards F, be deflected at B along the curved line B *a* C, the same power has to be exerted, for just the same effect is produced on the mass, as if it had been deflected at B, in the direction of BC, and at C in the direction CF. There would, however, be this difference, instead of the deflecting power being required at only two points, B and C, it would be required to be distributed along the whole length of the curve.

By this theory therefore, if the length and curvature of the line and the impinging force of the moving mass be known, it is easy to determine the lateral pressure upon each lineal foot of curvature. In applying it to the case in question, I assume that the weight of the engine and tender is correctly stated at 33 tons and the velocity at 30 miles per hour. The radius of the curve being two miles, the length of a quadrant curve would be about three miles, and though it might be difficult to determine the exact amount of impinging force, an approximate amount may easily be arrived at; impinging force being proportional to the velocity and gravity of the moving mass.

Thirty miles per hour is equal to 44 feet per second of time, and 33 tons moving at the rate of 44 feet per second, would be equivalent to 44 times 33 tons moving at the rate of 1 foot per second. This again would be equivalent to 12 times this amount of gravity or weight moving 1 inch per second, and this again to 4 times this amount moving one-fourth of an inch per second. 33 tons $\times$ 44 $\times$ 12 $\times$ 4 = 69,696 tons. But the impinging force of a body in motion let the motion be ever so slight, is greater than an equal body at rest; therefore the impinging force of 33 tons moving at the rate of 44 feet per second, is greater than 69,696 tons. We cannot consequently over estimate it, if we take it in round numbers at 70,000 tons.

It has been before shewn, that to divert the motion of the mass from the direction of one straight line to the direction of another straight line at right angles to it, its whole impinging force will have to be sustained. A quadrant curve of three miles in length, therefore, with a weight of 33 tons moving at 30 miles an hour, would have to sustain a lateral pressure of 70,000 tons distributed over its entire length. This would amount to 4½ tons per lineal foot nearly, and as the bite or hold of the flange of a driving wheel 5 ft. in diameter would be about 1 foot, there would be a constant and continuous pressure of 4½ tons. This is for the engine and tender alone. Every attached carriage would be under the same influence, and exert a pressure in proportion to its weight.

The weight of the attached train was about equal to that of the engine and tender, the lateral pressure would therefore be equal, and this will give an aggregate continuous pressure of about 9 tons.

This calculation is without allowing any thing for the pressure arising from the action of centrifugal force; which, as it would disturb the centre of gravity and throw it outwards, would increase the lateral pressure, though from the great radius of the curvature, in only a small degree. The action of centrifugal force, however, would have this important effect: it would throw the whole of the lateral pressure arising from the tendency of bodies in motion to persevere in a straight line, and which we estimate, as before shewn, at 9 tons, upon the outside line or rail of the curve, and consequently upon the outside girder of the bridge.

I take Mr. Kennedy's estimate of 70 tons on the centre as the correct breaking weight, for it is about the mean of the different estimates; and supposing the estimate of the permanent load on the girder, as furnished by your correspondent on the spot, to be also correct, it is equivalent to 28½ tons placed on the centre. This added to 33 tons, the weight of the engine and tender, and to 9 tons, my estimate of lateral pressure, will give 70½ tons, which is half a ton over the breaking weight. Again, Mr. Kennedy's estimate of 70 tons is on the assumption that the girder was in its proper vertical position, which, from the observation of your correspondent, that some of them yet remaining are as much as 1½ inch from this position, is very doubtful. In fact, the constant action of this great lateral pressure would have a tendency to disturb the vertical position of the girders, by straining and lengthening the tie-rods; and, in reply to Mr. Stephenson's argument, that greater weights moving with greater velocity had passed over this bridge with safety, I would observe, that this was when the entire structure was in its integrity, and before it had been weakened by constant straining.

In the case of the three engines, the weight would be about 100 tons, and the lateral pressure arising from the cause I have been endeavouring to explain, twenty-seven tons if they moved with the same velocity; but if the velocity was greater, the lateral pressure would be proportionably greater, and might possibly amount to forty tons. This great lateral pressure acting simultaneously with the vertical pressure would resolve, and manifest itself in the line of least resistance, and both a deflection of the girder and a great strain upon the transverse tie-rods would ensue, and it is not improbable that the tie-rods would occasionally be stretched, and thus allow the girder to deviate from its true vertical position, and thus become weaker in proportion as the deviation increased.

That the curvature of the line had to do with the deflection of the girder is farther made evident from the fact, which was clearly proved in the evidence, that with every increase of velocity in the passing train there was a corresponding increase in the deflection